"Ground-Based Solar Observations in Support of SOHO"

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In the two years covered by this proposal significant progress has been made in improving the capabilities of the SOONSPOT digital archive system as well as access to the tape data. During the next solar maximum, these improvements will complement not only SOHO observations, but they will augment observations made by the solar physics community as a whole.

The SOONSPOT system collects H-α and white light large scale images of active regions and other features and full disk H-α images from four observatories located around the world. The data are collected on 8-mm Exabyte tapes and sent to archives at the NOAA Space Environment Center in Boulder, CO. (managed by the P.I.) and also at the Lockheed Palo Alto Research Lab. (LPARL: managed by the YOHKOH team). The system originally implemented in May of 1994 was designed to record as many as 2000 images per day per site at solar maximum. However, it was realized during the first year of this grant that the system as then operating could handle the low volume demands of solar minimum but it would saturate (in terms of manpower) during solar maximum. The unforseen problem stems from the fact that data acquisition and data archival cannot occur simultaneously. Since the image processing systems must be shut down each day, this archival/acquisition conflict requires observers to wait for three hours or more each night for SOONSPOT archival during solar maximum — an unacceptable situation for everyone.

As indicated in the first annual report, a promising solution to the problem was to install large disk drives on the VAX computers that also archive the data to tape. As described in the first annual report, this was implemented at two test sites. The speed of daily archival was dramatically improved but it was found that archival from disk to tape again had to be performed when the system was not recording data. As of mid-November 1997, the P.I. working with U.S.A.F. personnel (particularly M. Sgt. Sky Yarbrough tested and implemented what is believed to be a final solution to the archival problems expected at solar maximum. The solution has been to install Pentium based P.C. computers that are networked to the VAX computers that drive SOONSPOT. Daily archival now consists of transferring images from the VAX to a large hard drive on the P.C. Final archive to tape occurs on the P.C. when enough data has been collected (2 - 2.7 Gbytes). Most importantly, the tape archival can occur while the system is collecting data with no impact on operations.

Not only should the system be able to operate at solar maximum (it has the potential to record five **different** flaring regions simultaneously with 30 s time resolution), but the newly implemented systems incorporate several other improvements and spinoff advantages. The U.S.A.F. purchased and installed faster new tape drives that write compressed data about five times faster than the older drives. The new tapes hold two to four times more data and play back much faster than before.

Since the data are written on P.C.s and read on Unix platforms, we have adopted entirely new software to write the data: specifically the UNIX "cpio" command which is also implemented on the P.C.s. Significant advantages include the use of wildcards in the filenames to facilitate extracting files on particular active regions or data that was taken on particular dates. Also the convenience and reliability of data retrieval should be considerably better than before.

In May of 1996, the P.I. visited the SOHO operations facility in Greenbelt, MD to familiarize the SOHO investigators with SOONSPOT data and to inspect the quality of their copy of the data that is produced by LPARL. This inspection lead to the discovery of a problem with their copy of the data which began in late 1995. At the request of Dr. Joe Gurman, it was suggested to make all future copies of SOONSPOT data on a 4 mm format. A new 4mm recorder was purchased under this grant and resides in a LPARL computer for this purpose. It is the current plan of this P.I. that all future tapes written with cpio on 8 mm format be copied in compressed form to 4 mm tapes and archived at SOHO's analysis facility at Goddard Space flight Center. Older tapes with problems could be copied in their native VMS format, or cpio format either in their entirity or on a specific request basis from SOHO.

To date, coordination of SOONSPOT with SOHO observations has primarily been carried out on an individual campaign or specific target basis. This has occurred because of differences in the two programs. SOHO can change targets and objectives every few hours while SOONSPOT targets can only be directed to change at 21:30 UT each day. Furthermore, SOHO has primarily focused on solar minium targets and scientific objectives (during minimum) while SOONSPOT's existence is based on detecting solar activity. Nevertheless, SOONSPOT has targeted polar plume regions, active and inactive filaments and even has supported special sun-centered quiet sun campaigns. SOONSPOT should be thought of as a multiple target pointed instrument as opposed to full disk concepts that inspired most of SOHO's instruments.

Recent use of SOONSPOT data has included the completion of a Master's thesis intitled "The Delta-Spot Growth and Formation of NOAA Active Region 7978 and its Relation to Nonlinear Numerical Simulations Models" by R. Meisner (U. Col. At Denver, 1997). The work featured analyses of more than 6000 SOONSPOT images taken during the active regions passage on the Sun. With some support from this grant we have also completed a full disk movie of solar rotation for 30 days at ~6h time resolution and 4 days at a resolution of ~30m. Another study has been carried out by an NSF REU student (Pete Zink) which is a search for Morton waves in SOONSPOT H-α data. More than 40 flares have been studied including recent EIT wave events as seen by SOHO.

In summary, this support has helped insure SOONSPOT observations since mid-1994 and it has also provided the needed support to develop SOONSPOT into a more efficient operation that should provide a comprehensive H-α database on the rise of solar maximum and to its peak.

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